

Package ‘asa’

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Title AI Search Agent for Large-Scale Research Automation

Version 0.1.0

Description Provides an LLM-powered research agent for performing AI search tasks at large scales. Uses a ReAct (Reasoning + Acting) agent pattern with web search capabilities via DuckDuckGo and Wikipedia. Implements DeepAgent-style memory folding for context management. The agent is built on 'LangGraph' and supports multiple LLM backends including 'OpenAI', 'Groq', and 'xAI'.

URL <https://github.com/cjerzak/asa-software>

BugReports <https://github.com/cjerzak/asa-software/issues>

Depends R (>= 4.0.0)

License GPL-3

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LazyData false

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rlang

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| |
|---|
| as.data.frame.asa_result |
| <i>Convert asa_result to Data Frame</i> |

Description

Convert asa_result to Data Frame

Usage

```
## S3 method for class 'asa_result'  
as.data.frame(x, ...)
```

Arguments

- x An asa_result object
- ... Additional arguments (ignored)

Value

A single-row data frame

| | |
|-----------|--|
| asa_agent | <i>Constructor for asa_agent Objects</i> |
|-----------|--|

Description

Creates an S3 object representing an initialized ASA search agent.

Usage

```
asa_agent(python_agent, backend, model, config)
```

Arguments

| | |
|--------------|---|
| python_agent | The underlying Python agent object |
| backend | LLM backend name (e.g., "openai", "groq") |
| model | Model identifier |
| config | Agent configuration list |

Value

An object of class `asa_agent`

| | |
|--------------|---|
| asa_response | <i>Constructor for asa_response Objects</i> |
|--------------|---|

Description

Creates an S3 object representing an agent response.

Usage

```
asa_response(  
    message,  
    status_code,  
    raw_response,  
    trace,  
    elapsed_time,  
    fold_count,  
    prompt  
)
```

Arguments

| | |
|--------------|--|
| message | The final response text |
| status_code | Status code (200 = success, 100 = error) |
| raw_response | The full Python response object |
| trace | Full text trace of agent execution |
| elapsed_time | Execution time in minutes |
| fold_count | Number of memory folds performed |
| prompt | The original prompt |

Value

An object of class `asa_response`

| | |
|-------------------------|--|
| <code>asa_result</code> | <i>Constructor for <code>asa_result</code> Objects</i> |
|-------------------------|--|

Description

Creates an S3 object representing the result of a research task.

Usage

```
asa_result(prompt, message, parsed, raw_output, elapsed_time, status)
```

Arguments

| | |
|---------------------------|-------------------------------|
| <code>prompt</code> | The original prompt |
| <code>message</code> | The agent's response text |
| <code>parsed</code> | Parsed output (list or NULL) |
| <code>raw_output</code> | Full agent trace |
| <code>elapsed_time</code> | Execution time in minutes |
| <code>status</code> | Status ("success" or "error") |

Value

An object of class `asa_result`

| | |
|----------------------------|---|
| <code>build_backend</code> | <i>Build the Python Backend Environment</i> |
|----------------------------|---|

Description

Creates a conda environment with all required Python dependencies for the asa search agent, including LangChain, LangGraph, and search tools.

Usage

```
build_backend(conda_env = "asa_env", conda = "auto", python_version = "3.13")
```

Arguments

| | |
|-----------------------------|--|
| <code>conda_env</code> | Name of the conda environment (default: "asa_env") |
| <code>conda</code> | Path to conda executable (default: "auto") |
| <code>python_version</code> | Python version to use (default: "3.13") |

Details

This function creates a new conda environment and installs the following Python packages:

- langchain_groq, langchain_community, langchain_openai
- langgraph
- ddgs (DuckDuckGo search)
- selenium, primp (browser automation)
- beautifulsoup4, requests
- fake_headers, httpx
- pysocks, socksio (proxy support)

Value

Invisibly returns NULL; called for side effects.

Examples

```
## Not run:
# Create the default environment
build_backend()

# Create with a custom name
build_backend(conda_env = "my_asa_env")

## End(Not run)
```

build_prompt

Build a Task Prompt from Template

Description

Creates a formatted prompt by substituting variables into a template.

Usage

```
build_prompt(template, ...)
```

Arguments

| | |
|----------|--|
| template | A character string with placeholders in the form {variable_name} |
| ... | Named arguments to substitute into the template |

Value

A formatted prompt string

Examples

```
## Not run:
prompt <- build_prompt(
  template = "Find information about {{name}} in {{country}} during {{year}}",
  name = "Marie Curie",
  country = "France",
  year = 1903
)

## End(Not run)
```

check_backend

Check Python Environment Availability

Description

Checks if the required Python environment and packages are available.

Usage

```
check_backend(conda_env = "asa_env")
```

Arguments

conda_env Name of the conda environment to check

Value

A list with components:

- available: Logical, TRUE if environment is ready
- conda_env: Name of the environment checked
- python_version: Python version if available
- missing_packages: Character vector of missing packages (if any)

Examples

```
## Not run:
status <- check_backend()
if (!status$available) {
  build_backend()
}

## End(Not run)
```

configure_search

*Configure Python Search Parameters***Description**

Sets global configuration values for the Python search module. These values control timeouts, retry behavior, and result limits.

Usage

```
configure_search(
    max_results = NULL,
    timeout = NULL,
    max_retries = NULL,
    retry_delay = NULL,
    backoff_multiplier = NULL,
    captcha_backoff_base = NULL,
    page_load_wait = NULL,
    inter_search_delay = NULL,
    conda_env = "asa_env"
)
```

Arguments

| | |
|----------------------|--|
| max_results | Maximum number of search results to return (default: 10) |
| timeout | HTTP request timeout in seconds (default: 15) |
| max_retries | Maximum retry attempts on failure (default: 3) |
| retry_delay | Initial delay between retries in seconds (default: 2) |
| backoff_multiplier | Multiplier for exponential backoff (default: 1.5) |
| captcha_backoff_base | Base multiplier for CAPTCHA backoff (default: 3) |
| page_load_wait | Wait time after page load in seconds (default: 2) |
| inter_search_delay | Delay between consecutive searches in seconds (default: 0.5) |
| conda_env | Name of the conda environment (default: "asa_env") |

Value

Invisibly returns a list with the current configuration

Examples

```
## Not run:
# Increase timeout for slow connections
configure_search(timeout = 30, max_retries = 5)

# Get more results
configure_search(max_results = 20)
```

```
# Add delay between searches to avoid rate limiting
configure_search(inter_search_delay = 2.0)

## End(Not run)
```

```
configure_search_logging
```

Configure Python Search Logging Level

Description

Sets the logging level for the Python search module. This controls how much diagnostic output is produced during web searches.

Usage

```
configure_search_logging(level = "WARNING", conda_env = "asa_env")
```

Arguments

| | |
|-----------|---|
| level | Log level: "DEBUG", "INFO", "WARNING" (default), "ERROR", or "CRITICAL" |
| conda_env | Name of the conda environment (default: "asa_env") |

Details

Log levels from most to least verbose:

- DEBUG: Detailed diagnostic information for debugging
- INFO: General operational information
- WARNING: Indicates something unexpected but not an error (default)
- ERROR: Serious problems that prevented an operation
- CRITICAL: Very serious errors

Value

Invisibly returns the current logging level

Examples

```
## Not run:
# Enable verbose debugging output
configure_search_logging("DEBUG")

# Run a search (will show detailed logs)
result <- run_task("What is the population of Tokyo?", agent = agent)

# Disable verbose output
configure_search_logging("WARNING")

## End(Not run)
```

extract_agent_results *Extract Structured Data from Agent Traces*

Description

Parses raw agent output to extract search snippets, Wikipedia content, URLs, JSON data, and search tier information. This is the main function for post-processing agent traces.

Usage

```
extract_agent_results(raw_output)
```

Arguments

| | |
|------------|---|
| raw_output | Raw output string from agent invocation (the trace field from an asa_response object) |
|------------|---|

Value

A list with components:

- search_snippets: Character vector of search result content
- search_urls: Character vector of URLs from search results
- wikipedia_snippets: Character vector of Wikipedia content
- json_data: Extracted JSON data as a list (if present)
- search_tiers: Character vector of unique search tiers used (e.g., "primp", "selenium", "ddgs", "requests")

Examples

```
## Not run:
response <- run_agent("Who is the president of France?", agent)
extracted <- extract_agent_results(response$trace)
print(extracted$search_snippets)
print(extracted$search_tiers) # Shows which search tier was used

## End(Not run)
```

extract_search_snippets*Extract Search Snippets by Source Number*

Description

Extracts content from Search tool messages in the agent trace.

Usage

```
extract_search_snippets(text)
```

Arguments

text Raw agent trace text

Value

Character vector of search snippets, ordered by source number

Examples

```
## Not run:
snippets <- extract_search_snippets(response$trace)

## End(Not run)
```

extract_search_tiers *Extract Search Tier Information*

Description

Extracts which search tier was used from the agent trace. The search module uses a multi-tier fallback system:

- primp: Fast HTTP client with browser impersonation (Tier 0)
- selenium: Headless browser for JS-rendered content (Tier 1)
- ddgs: Standard DDGS Python library (Tier 2)
- requests: Raw POST to DuckDuckGo HTML endpoint (Tier 3)

Usage

```
extract_search_tiers(text)
```

Arguments

text Raw agent trace text

Value

Character vector of unique tier names encountered (e.g., "primp", "selenium", "ddgs", "requests")

Examples

```
## Not run:
tiers <- extract_search_tiers(response$trace)
print(tiers) # e.g., "primp"

## End(Not run)
```

| | |
|--------------|--------------------------------------|
| extract_urls | <i>Extract URLs by Source Number</i> |
|--------------|--------------------------------------|

Description

Extracts URLs from Search tool messages in the agent trace.

Usage

```
extract_urls(text)
```

Arguments

| | |
|------|----------------------|
| text | Raw agent trace text |
|------|----------------------|

Value

Character vector of URLs, ordered by source number

Examples

```
## Not run:  
urls <- extract_urls(response$trace)  
  
## End(Not run)
```

| | |
|---------------------------|----------------------------------|
| extract_wikipedia_content | <i>Extract Wikipedia Content</i> |
|---------------------------|----------------------------------|

Description

Extracts content from Wikipedia tool messages in the agent trace.

Usage

```
extract_wikipedia_content(text)
```

Arguments

| | |
|------|----------------------|
| text | Raw agent trace text |
|------|----------------------|

Value

Character vector of Wikipedia snippets

Examples

```
## Not run:
wiki <- extract_wikipedia_content(response$trace)

## End(Not run)
```

get_agent

Get the Current Agent

Description

Returns the currently initialized agent, or NULL if not initialized.

Usage

```
get_agent()
```

Value

An asa_agent object or NULL

Examples

```
## Not run:
agent <- get_agent()
if (is.null(agent)) {
  agent <- initialize_agent()
}

## End(Not run)
```

get_tor_ip

Get External IP via Tor

Description

Retrieves the external IP address as seen through Tor proxy.

Usage

```
get_tor_ip(proxy = "socks5h://127.0.0.1:9050")
```

Arguments

proxy Tor proxy URL

Value

IP address string or NA on failure

Examples

```
## Not run:
ip <- get_tor_ip()
message("Current Tor IP: ", ip)

## End(Not run)
```

| | |
|------------------|--|
| initialize_agent | <i>Initialize the ASA Search Agent</i> |
|------------------|--|

Description

Initializes the Python environment and creates the LangGraph agent with search tools (Wikipedia, DuckDuckGo). The agent can use multiple LLM backends and supports DeepAgent-style memory folding.

Usage

```
initialize_agent(
  backend = "openai",
  model = "gpt-4.1-mini",
  conda_env = "asa_env",
  proxy = "socks5h://127.0.0.1:9050",
  use_memory_folding = TRUE,
  memory_threshold = 4L,
  memory_keep_recent = 2L,
  rate_limit = 0.2,
  timeout = 120L,
  verbose = TRUE
)
```

Arguments

| | |
|--------------------|---|
| backend | LLM backend to use. One of: "openai", "groq", "xai", "exo", "openrouter" |
| model | Model identifier (e.g., "gpt-4.1-mini", "llama-3.3-70b-versatile") |
| conda_env | Name of the conda environment with Python dependencies |
| proxy | SOCKS5 proxy URL for Tor (default: "socks5h://127.0.0.1:9050"). Set to NULL to disable proxy. |
| use_memory_folding | Enable DeepAgent-style memory compression (default: TRUE) |
| memory_threshold | Number of messages before folding triggers (default: 4) |
| memory_keep_recent | Number of recent messages to preserve after folding (default: 2) |
| rate_limit | Requests per second for rate limiting (default: 0.2) |
| timeout | Request timeout in seconds (default: 120) |
| verbose | Print status messages (default: TRUE) |

Details

The agent is created with two tools:

- Wikipedia: For looking up encyclopedic information
- DuckDuckGo Search: For web searches with a 4-tier fallback system (PRIMP -> Selenium -> DDGS library -> raw requests)

Memory folding (enabled by default) compresses older messages into a summary to manage context length in long conversations, following the DeepAgent paper.

Value

An object of class `asa_agent` containing the initialized agent and configuration.

API Keys

The following environment variables should be set based on your backend:

- OpenAI: `OPENAI_API_KEY`
- Groq: `GROQ_API_KEY`
- xAI: `XAI_API_KEY`
- OpenRouter: `OPENROUTER_API_KEY`

OpenRouter Models

When using the "openrouter" backend, model names must be in provider/model-name format. Examples:

- "openai/gpt-4o"
- "anthropic/claude-3-sonnet"
- "google/gemma-2-9b-it:free"
- "meta-llama/llama-3-70b-instruct"

See <https://openrouter.ai/models> for available models.

See Also

[run_agent](#), [run_task](#)

Examples

```
## Not run:
# Initialize with OpenAI
agent <- initialize_agent(
  backend = "openai",
  model = "gpt-4.1-mini"
)

# Initialize with Groq and custom settings
agent <- initialize_agent(
  backend = "groq",
  model = "llama-3.3-70b-versatile",
  use_memory_folding = FALSE,
  proxy = NULL # No Tor proxy
```

```
)

# Initialize with OpenRouter (access to 100+ models)
agent <- initialize_agent(
  backend = "openrouter",
  model = "anthropic/claude-3-sonnet" # Note: provider/model format
)

## End(Not run)
```

| | |
|----------------|--------------------------------|
| is_tor_running | <i>Check if Tor is Running</i> |
|----------------|--------------------------------|

Description

Checks if Tor is running and accessible on the default port.

Usage

```
is_tor_running(port = 9050L)
```

Arguments

| | |
|------|-----------------------------|
| port | Port number (default: 9050) |
|------|-----------------------------|

Value

Logical indicating if Tor appears to be running

Examples

```
## Not run:
if (!is_tor_running()) {
  message("Start Tor with: brew services start tor")
}

## End(Not run)
```

| | |
|-----------------|---|
| print.asa_agent | <i>Print Method for asa_agent Objects</i> |
|-----------------|---|

Description

Print Method for asa_agent Objects

Usage

```
## S3 method for class 'asa_agent'
print(x, ...)
```

Arguments

| | |
|-----|--------------------------------|
| x | An asa_agent object |
| ... | Additional arguments (ignored) |

Value

Invisibly returns the object

| | |
|--------------------|--|
| print.asa_response | <i>Print Method for asa_response Objects</i> |
|--------------------|--|

Description

Print Method for asa_response Objects

Usage

```
## S3 method for class 'asa_response'  
print(x, ...)
```

Arguments

| | |
|-----|--------------------------------|
| x | An asa_response object |
| ... | Additional arguments (ignored) |

Value

Invisibly returns the object

| | |
|------------------|--|
| print.asa_result | <i>Print Method for asa_result Objects</i> |
|------------------|--|

Description

Print Method for asa_result Objects

Usage

```
## S3 method for class 'asa_result'  
print(x, ...)
```

Arguments

| | |
|-----|--------------------------------|
| x | An asa_result object |
| ... | Additional arguments (ignored) |

Value

Invisibly returns the object

| | |
|-----------------|---------------------------------------|
| process_outputs | <i>Process Multiple Agent Outputs</i> |
|-----------------|---------------------------------------|

Description

Processes a data frame of raw agent outputs, extracting structured data.

Usage

```
process_outputs(df, parallel = FALSE, workers = 10L)
```

Arguments

| | |
|----------|---|
| df | Data frame with a 'raw_output' column containing agent traces |
| parallel | Use parallel processing |
| workers | Number of workers |

Value

The input data frame with additional extracted columns: search_count, wiki_count, and any JSON fields found

| | |
|-------------|------------------------|
| reset_agent | <i>Reset the Agent</i> |
|-------------|------------------------|

Description

Clears the initialized agent state, forcing reinitialization on next use. Also closes any open HTTP clients to prevent resource leaks.

Usage

```
reset_agent()
```

Value

Invisibly returns NULL

| | |
|--------------------|---------------------------|
| rotate_tor_circuit | <i>Rotate Tor Circuit</i> |
|--------------------|---------------------------|

Description

Requests a new Tor circuit by restarting the Tor service.

Usage

```
rotate_tor_circuit(method = c("brew", "systemctl", "signal"), wait = 12L)
```

Arguments

| | |
|--------|---|
| method | Method to restart: "brew" (macOS), "systemctl" (Linux), or "signal" |
| wait | Seconds to wait for new circuit (default: 12) |

Value

Invisibly returns NULL

Examples

```
## Not run:
rotate_tor_circuit()

## End(Not run)
```

| | |
|-----------|---|
| run_agent | <i>Run the ASA Agent with a Custom Prompt</i> |
|-----------|---|

Description

Invokes the search agent with an arbitrary prompt, returning the full agent trace and response. This is the low-level function for running the agent; for structured task execution, use [run_task](#).

Usage

```
run_agent(prompt, agent = NULL, recursion_limit = NULL, verbose = FALSE)
```

Arguments

| | |
|-----------------|---|
| prompt | The prompt to send to the agent |
| agent | An asa_agent object from initialize_agent , or NULL to use/create the default agent |
| recursion_limit | Maximum number of agent steps (default: 100 for memory folding, 20 otherwise) |
| verbose | Print status messages (default: FALSE) |

Value

An object of class `asa_response` containing:

- `message`: The final response text
- `status_code`: 200 for success, 100 for error
- `raw_response`: The full Python response object
- `trace`: Full text trace of agent execution
- `elapsed_time`: Execution time in minutes
- `fold_count`: Number of memory folds (if memory folding enabled)

See Also

[initialize_agent](#), [run_task](#)

Examples

```
## Not run:
# Run with a custom prompt
agent <- initialize_agent()
result <- run_agent(
  prompt = "Who was the 44th president of the United States?",
  agent = agent
)
print(result$message)

## End(Not run)
```

run_agent_batch

Run Agent in Batch Mode

Description

Runs the agent on multiple prompts, optionally in parallel.

Usage

```
run_agent_batch(
  prompts,
  agent = NULL,
  parallel = FALSE,
  workers = 4L,
  progress = TRUE
)
```

Arguments

| | |
|-----------------------|--|
| <code>prompts</code> | Character vector of prompts |
| <code>agent</code> | An <code>asa_agent</code> object |
| <code>parallel</code> | Use parallel processing (requires <code>future.apply</code> package) |
| <code>workers</code> | Number of parallel workers (default: 4) |
| <code>progress</code> | Show progress bar (default: TRUE) |

Value

A list of `asa_response` objects

Examples

```
## Not run:
prompts <- c(
  "What is the population of Tokyo?",
  "What is the population of New York?"
)
results <- run_agent_batch(prompts, agent)

## End(Not run)
```

| | |
|----------|---|
| run_task | <i>Run a Structured Task with the Agent</i> |
|----------|---|

Description

Executes a research task using the AI search agent with a structured prompt and returns parsed results.

Usage

```
run_task(prompt, output_format = "text", agent = NULL, verbose = FALSE)
```

Arguments

| | |
|---------------|--|
| prompt | The task prompt or question for the agent to research |
| output_format | Expected output format. One of: "text" (raw response), "json" (parse as JSON), or a character vector of field names to extract |
| agent | An <code>asa_agent</code> object from initialize_agent , or NULL to use the currently initialized agent |
| verbose | Print progress messages (default: FALSE) |

Details

This function provides a high-level interface for running research tasks. For simple text responses, use `output_format = "text"`. For structured outputs, use `output_format = "json"` or specify field names to extract.

Value

An object of class `asa_result` with components:

- `prompt`: The original prompt
- `message`: The agent's response text
- `parsed`: Parsed output (if `output_format` specified)
- `raw_output`: Full agent trace
- `elapsed_time`: Execution time in minutes
- `status`: "success" or "error"

See Also

[initialize_agent](#), [run_agent](#), [run_task_batch](#)

Examples

```
## Not run:
# Initialize agent first
agent <- initialize_agent(backend = "openai", model = "gpt-4.1-mini")

# Simple text query
result <- run_task(
  prompt = "What is the capital of France?",
  output_format = "text",
  agent = agent
)
print(result$message)

# JSON structured output
result <- run_task(
  prompt = "Find information about Albert Einstein and return JSON with
           fields: birth_year, death_year, nationality, field_of_study",
  output_format = "json",
  agent = agent
)
print(result$parsed)

## End(Not run)
```

run_task_batch

Run Multiple Tasks in Batch

Description

Executes multiple research tasks, optionally in parallel.

Usage

```
run_task_batch(
  prompts,
  output_format = "text",
  agent = NULL,
  parallel = FALSE,
  workers = 4L,
  progress = TRUE
)
```

Arguments

| | |
|---------------|--|
| prompts | Character vector of task prompts, or a data frame with a 'prompt' column |
| output_format | Expected output format (applies to all tasks) |
| agent | An <code>asa_agent</code> object |

| | |
|----------|----------------------------|
| parallel | Use parallel processing |
| workers | Number of parallel workers |
| progress | Show progress messages |

Value

A list of `asa_result` objects, or if prompts was a data frame, the data frame with result columns added

Examples

```
## Not run:
prompts <- c(
  "What is the population of Tokyo?",
  "What is the population of New York?",
  "What is the population of London?"
)
results <- run_task_batch(prompts, agent = agent)

## End(Not run)
```

| | |
|-------------------|---|
| summary.asa_agent | <i>Summary Method for asa_agent Objects</i> |
|-------------------|---|

Description

Summary Method for `asa_agent` Objects

Usage

```
## S3 method for class 'asa_agent'
summary(object, ...)
```

Arguments

| | |
|--------|----------------------------------|
| object | An <code>asa_agent</code> object |
| ... | Additional arguments (ignored) |

Value

Invisibly returns a summary list

summary.asa_response *Summary Method for asa_response Objects*

Description

Summary Method for asa_response Objects

Usage

```
## S3 method for class 'asa_response'  
summary(object, show_trace = FALSE, ...)
```

Arguments

| | |
|------------|--------------------------------|
| object | An asa_response object |
| show_trace | Include full trace in output |
| ... | Additional arguments (ignored) |

Value

Invisibly returns a summary list

summary.asa_result *Summary Method for asa_result Objects*

Description

Summary Method for asa_result Objects

Usage

```
## S3 method for class 'asa_result'  
summary(object, ...)
```

Arguments

| | |
|--------|--------------------------------|
| object | An asa_result object |
| ... | Additional arguments (ignored) |

Value

Invisibly returns a summary list

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